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SOME ECONOMIC CONSIDERATIONS IN ASSESSING
DIVERSION PROGRAMS FOR APPLES

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I. Introduction

From time to time in the apple industry, there has been interest in establishing a diversion program for fresh and processing apples. Such a program would, of course, be based on the well-known economic concept of price discrimination. While this concept is relatively simple theoretically, its application to an agricultural commodity is apt to prove more difficult.

The problems, in fact, are many. They range from the theoretical to the practical, and vary from the short run to the long run. In the case of apples, some of the difficulties of a program involving fresh and processing apples have been discussed by this writer,^{2/} Bartter,^{3/} Pasour,^{4/} and Tomek.^{5/} One of the more critical and immediate areas of concern, it

^{1/}Economist, Fruit and Vegetable Marketing. Drs. E. C. Pasour of North Carolina State College and W. G. Tomek of Cornell University reviewed an earlier draft of the paper and provided several helpful suggestions.

^{2/}Dana G. Dalrymple, "Economic Aspects of Apple Marketing in the United States," Michigan State University, Ph. D. dissertation, 1962, pp. 248-254, 319-330. Portions of these sections have been presented in revised and expanded form in the following FES publications: Studies on the Economic Aspects of Fruit and Vegetable Bargaining, Mimeo D-4, February 1963, pp. 20-28; and Price Discrimination with Unequal Costs, Mimeo D-5 February 1963, 5 pp.

^{3/}Lynn M. Bartter, Effects of Apple Supply Management Programs in New York State, Cornell University, Department of Agricultural Economics, A. E. Res. 62, April 1961, pp. 1-8.

^{4/}E. C. Pasour, Jr., "An Analysis of Intraseasonal Apple Price Movements," Michigan State University, Ph. D. dissertation, 1963, pp. 131-143.

^{5/}William G. Tomek, Cornell University, Department of Agricultural Economics: An Analysis of Changes in Annual Average Apple Prices in New York State, A. E. Res. 112, May 1963, pp. 20-21; An Analysis of Changes in the Utilization of Apples in the United States, A. E. Res. 137, December 1963, pp. 26-28.

has become apparent, is the nature of the short-run demand relationship at the farm level.^{6/}

This paper, therefore, brings together recent information pertaining to the price elasticity of demand for fresh and processing (canning and freezing) apples at the farm level. The material is then analyzed in terms of its theoretical meaning for broad-scale diversion programs.^{7/} Although the paper is brief, it is hoped that it will help focus attention on several key issues.

II. Elasticities Derived from Annual Data

Studies of price elasticity of demand using annual data have tended to indicate that the demand at the farm level for fresh apples is more elastic than the demand for processing (canning and freezing) apples. The difference in elasticity in some cases, however, was small, and in one instance the elasticity for fresh was less. Specific figures, with qualifying notes, are provided in Table 1.^{8/}

This writer would generally expect a somewhat less elastic demand for processing apples at the farm level because of the many services involved in processing. The marketing margin for processing apples appears to be greater than for fresh and is likely to be less flexible. Furthermore, if the demand for processing apples were less elastic, a greater fluctuation

^{6/}The relationship at the retail level is also of interest, but is perhaps of less immediate concern. For further discussion see Dalrymple, loc. cit. (1962), and Pasour, loc. cit.

^{7/}Considerations in conducting a State-wide program are discussed by Tomek, loc. cit., (May).

^{8/}Two writers - Drew and Greig - have imputed that the elasticity of demand for processing is greater than for fresh at the farm level. They did not, however, derive or present any specific elasticities. Drew's work is discussed by Dalrymple, op. cit., pp. 244-245, and Greig's by Pasour, op. cit., pp. 137-139.

Table 1. PRICE ELASTICITIES OF DEMAND FOR FRESH
AND PROCESSING APPLES AT THE FARM LEVEL
United States, Annual Data 1/

A. Ordinary Least Squares

<u>Study</u>	<u>Quantity Dependent</u>		<u>Price Dependent^{2/}</u>	
	<u>Fresh</u>	<u>Processing</u>	<u>Fresh</u>	<u>Processing</u>
Brandow	-0.68	-0.13 ^{3/}	-0.85	-0.68 ^{3/}
Bartter	NA	NA	-0.77	-0.59
Tomek	-0.39	-0.17 ^{4/}	NA	NA

B. Simultaneous Equations

<u>Study</u>	<u>Fresh</u>	<u>Processing</u>
Brandow (LISE) ^{5/}	-0.73	-0.21
Tomek I (TSLS) ^{6/}	-0.46	-0.57
Tomek II (TSLS) ^{6/}	-0.47	-0.45

Notes:

^{1/}Post-war period. "Processing" refers to apples for canning and freezing.

^{2/}These elasticities were transformed from price flexibilities. Because the cross elasticities of demand between the fresh and processing apples is undoubtedly greater than zero, they may not be as reliable as those computed with quantity dependent (see Dalrymple, op. cit., p. 241, fn. 24).

^{3/}Canning only.

^{4/}This coefficient is less than two times larger than its standard error.

^{5/}Limited information, single equation.

^{6/}Two-stage least squares. Formulations I and II differed in the way production was classified: I was on a regional basis, and II on a variety basis.

General. Harrington estimated that the elasticity of demand for fresh apples was probably -0.5 or less (Albert Harrington, "Demand for Fresh Market Apples," University of Illinois, Ph. D. dissertation, May 1962, p. 172).

Sources:

G. E. Brandow, A Statistical Analysis of Apple Supply and Demand, Pennsylvania State University, Department of Agricultural Economics, AE and RS 2, January 1956, pp. 2, 20. While Brandow studied the 1934 to 1953 period (excluding 1942-46) his elasticities were computed with post-war averages.

Bartter, op. cit., p. 3.

Tomek, op. cit. (December), p. 24.

in farm prices might be expected with variations in crop size. This, indeed, was found to be the case for the post-war period - though the difference was small.^{9/}

On balance, though, the facts that the relationship between fresh and processed elasticities is not entirely consistent, and that the difference is relatively small, would argue against accepting any particular relationship at this time. In turn this would mean that a diversion program could not be very strongly recommended on a theoretical basis at this time.

III. Elasticities Derived from Seasonal Data

Although most elasticity figures have been developed from annual data - primarily because of convenience - it should be recognized that it is quite possible to develop elasticities for shorter periods. There are two reasons for doing this in the case of apples: (a) the annual figures are apt to be minimal elasticities because of the influence of storage,^{10/} and (b) the annual figures may be less appropriate for decision-making than the actual elasticities during the fall period.

The latter point may be clarified if one recognizes that the elasticities for processing (canning and freezing) apples used in the previous section were based on sales over a few months in the fall, while the fresh figures were based on sales over a twelve-month season. Therefore, if we are to compare elasticities for diversion purposes, some thought might be given to doing so for the same period. Pasour was the first to compute seasonal elasticities at the farm level. His results are presented in Table 2.

^{9/}Dalrymple, op. cit., pp. 244 (fn. 28), 207-208.

^{10/}Ibid., p. 232. Based on G. S. Shepherd, Agricultural Price Analysis (4th edition), Iowa State College Press, Ames, 1957, p. 67.

Table 2. PRICE ELASTICITIES OF DEMAND FOR ALL
AND FRESH APPLES AT THE FARM LEVEL
United States, Seasonal Data^{1/}

<u>Period</u>	<u>All</u>	<u>Fresh</u>
I (July-November)	-0.42 ^{2/}	-0.35 ^{3/}
II (December-March)	NA	-0.75 ^{4/}
III (April-June)	NA	-1.33 ^{5/}

Notes:

^{1/}1947-61 period computed by least squares, logarithms, quantity dependent.

^{2/}The R^2 of the overall relationship was not reported for this function, but was 0.69 when actual data was used with price dependent.

^{3/} $R^2 = 0.46$

^{4/} $R^2 = 0.92$

^{5/} $R^2 = 0.86$

Source:

Pasour, op. cit., pp. 100, 103, 109.

Elasticities were not computed for all apples in periods II and III.^{11/}

An attempt was made to derive elasticities for processing apples, but the relationships were not satisfactory.

Even so, the data are of interest from two points of view. They suggest that (a) while fresh elasticity climbs sharply through the season,^{2/} (b) during the harvest period the elasticity for fresh apples may be less than for all apples, and hence less than for processing. Because the fits were not particularly good during the harvest period, however, Pasour indicates that "The analysis was not adequate . . . to conclude that there was, in fact, a difference in the elasticity of demand in processing and fresh apple markets."^{13/} Again, more study seems desirable.

^{11/}But because of the negligible quantities of apples sold for processing during these periods, the elasticity for all apples might be expected to be similar to the fresh figure.

^{12/}This is the same general relationship (with one exception) this writer found at the retail level (Dalrymple, op. cit., pp. 238-239).

^{13/}Pasour, op. cit., p. 139.

IV. Considerations in Using Seasonal Elasticities

Although Pasour is cautious about the use of his data, they do suggest several interesting theoretical problems. If, for example, we overlook the general relationship previously noted for annual elasticities and assume that his suggested relationship is in fact valid, we can see several possible complications.

The basic problem centers about apples in storage. Pasour's fresh elasticities were based on apples going directly to market during period I. They did not include apples that went into storage during the period. Since only about 40% of the apples ultimately used fresh during the 1945-60 period went directly to market, while about 60% went into storage, the latter is an item of some consequence. Therefore, if we were to divert apples - say in November - from the quantity going directly to market into processing (for canning and freezing), we would very likely be faced with a concurrent flow of apples from storage to the fresh market. In other words the large quantity of storage apples could not, even in the simplest case, be regarded as fixed. Furthermore, the apples could flow to both markets - though more likely to the one where quantity is otherwise limited (fresh in this case) - and throw the anticipated diversion program awry.^{14/} And if the diversion program were enacted in earlier months, perhaps it would influence the flow of apples which would ordinarily have gone to storage.^{15/}

^{14/}From 1953 to 1960, about 9% of the apples in storage on November 1 were being held specifically for processing while the rest were presumably held for fresh market. Some fresh varieties could be used for processing and vice versa (Dalrymple, op. cit., p. 89).

^{15/}The degree of influence of price, however, might not be as great as expected. Previous work by this writer indicated that the correlation (r^2) between size of crop and December 1 holdings was 0.66. Addition of average October price increased the figure to only 0.67 (p. 83). Pasour

A further problem is that a large portion of apples in storage are still owned by the growers and are stored in their own storage. Therefore, if growers were operating a diversion program they would be faced with the situation of shifting their direct-to-market apples to processing, while at the same time either not placing fewer apples than usual in storage, or withdrawing more. This could provide too strong a temptation for many.

On the other hand, because of the increase in fresh elasticity and the general increase in price through the season,^{16/} the industry might find it desirable to keep more - not less - apples for late season sale. There are certain temptations for growers to put apples in storage - and particularly into Controlled Atmosphere. Basically the reason is that if growers own storage space, they are likely to fill it because the operation cost is relatively low compared to the overhead.^{17/} And generally there is enough of a price increase during the season to at least cover operating costs. For these and other reasons we might expect a storage demand of some nature for apples. It would not be a normal demand in the case of grower-owned businesses, because most of the apples are not placed on the market, but sort of a reservation demand. Pasour attempted to develop a

^{15/}developed a storage function which had an \bar{R}^2 of 0.82 and which included data on apple production by regions (Eastern and other), a processing-fresh price ratio, and an error term. Significantly, the partial correlation coefficient for the processing-fresh price ratio was only 0.08 (pp. 70, 193).

^{16/}Although this relationship might be expected from a movement along an existing demand curve due to the smaller quantities marketed later in the season, there is some reason to believe that there may have been a shift in demand in recent years (Dalrymple, op. cit., pp. 253-254, Tomek, op. cit., December, p. 11).

^{17/}See Dalrymple, op. cit., pp. 72-73.

storage demand function but found (as indicated in fn. 14) that changes in price did not appear to have a significant effect on quantity stored.

So we return to the point that storage stocks of apples would present formidable - if not entirely understood - problems for a diversion program based on fall elasticities.

V. Conclusions

On the basis of the economic information presented in this report, this writer would have serious reservations about enacting a diversion program for fresh and processing apples. At the present time the basic demand relationships between fresh and processed apples at the farm level are too unclear to make enlightened operation of a diversion program possible. If any recommendation is to be made at this point, it would probably be to use elasticities derived from annual data to allocate apples among uses and elasticities derived from quarterly data to allocate fresh apple utilization among seasons. But even if the theoretical problems discussed here at the farm level were clarified, there would remain longer run theoretical problems at the farm and retail level, in addition to a host of more practical problems.^{18/}

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^{18/}These further problems are, as previously noted, discussed in the publications noted in fns. 2, 3, 4 and 5.

